E-mail access to NetCME: Implementation of server push paradigm

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We describe the implementation of a Continuing Medical Education project which utilizes e-mail delivery of HTML documents to facilitate participant access to case material. HTML e-mail is displayed directly within the e-mail reader of the Netscape browser. This system of proactive educational content delivery ensures simultaneous distribution to all participants. Although a more effective method of content distribution, the system preserves user confidentiality and maintains security. HTML e-mail is non-proprietary and could be integrated into existing Internet-based educational projects to facilitate user access.
Project address: <http://netcme.mdacc.tmc.edu>

INTRODUCTION

Recent reports regarding the Internet have publicized an evolution of the World Wide Web from a pull medium to a push medium.[1] In this revised Internet delivery model, user surfing to web sites to retrieve content ("pull"), is replaced by a model of content delivery directly to the user's computer ("push"). This method of content delivery ensures that an HTML document will be delivered to a given list of participants without reliance upon random visits to a web site and random searches for interesting pages.

We describe the implementation a Continuing Medical Education (CME) project which relies entirely upon this "push model" of content delivery for physician interaction. It employs an interim "push" technology of e-mail delivery of HTML pages directly to subscribers. URL links are included for subscribers with e-mail browsers not able to interpret the HTML encoding. The model proves effective and efficient for accessing Internet-based self-assessment content .

METHODS

This implementation was designed to support the "NetCME" project that delivers weekly case presentations to subscribers.[2] Case presentations include an initial HTML page where medical images and clinical history of an unknown diagnosis are presented and the user submits a diagnosis. CME credit is accumulated through answering of multiple choice questions which provide objective assessment. CME subscribers accumulate 12 minutes of Category I CME credit for each completed case. Free subscriptions are also available. A worldwide network of multiple image servers in employed. For example, an Australian participant retrieves HTML pages from Houston, TX and images automatically from an image server in Australia.

1. Enter URL for site - or activate Bookmark
2. Enter user name and password
3. Review available case selections
4. Select specific case

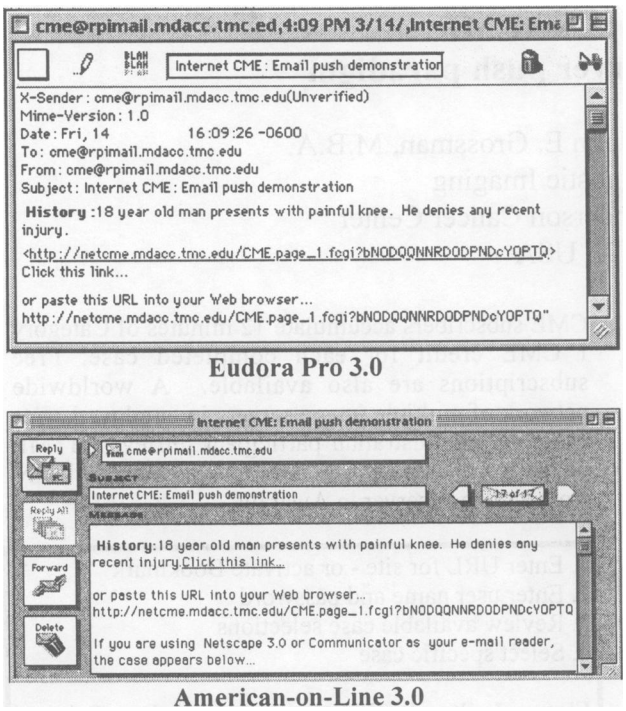
Figure 1. Standard Web site interaction: Original project's sign-on required four step process to retrieve a specific case for CME review.

With the original system, during a registration process participants were assigned a user name and password. When a new case was available an e-mail message was sent to participants who would then have to visit the site, enter name/password, review list of available cases, and select the case for review. Figure 1. A CGI script then generated the first HTML page for the case and returned it to the client.

The sign-on routine was typical of the majority of web sites requiring a user name/password. While ensuring proper user tracking and system security, it was inefficient as most participants selected the case announced by our e-mail message yet still had to complete the sign-on routine for every case.

HTML e-mail.
The function of an e-mail client is to receive electronic messages and then display them. The function of a Internet browser is to retrieve text from a web site and then correctly display the document with format instructions included as HTML tags. In HTML e-mail the e-mail message contains HTML formatting which the e-mail client displays.

This capability for HTML e-mail display is integrated into the Netscape Navigator 3.0 and Communicator browser. The commercial product is called "In-box Direct". The concept of In-box Direct is to deliver ("push") an e-mail message to a subscriber which is actually an HTML document/Web page. Netscape



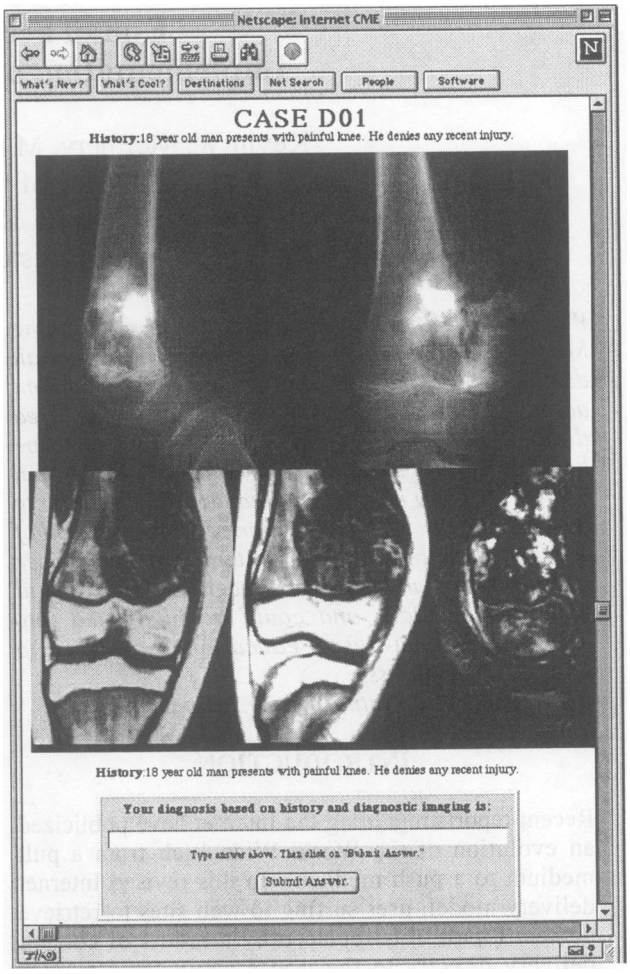


Figure 2. E-mail interaction non-MIME clients. With standard e-mail clients (above) the notification HTML e-mail message is displayed in a conventional manner. Upon clicking the embedded link or pasting the URL into browser the first page of the CME lesson for the case is displayed (right). User information, encrypted in the URL is automatically embedded in hidden form fields.

Communications describes this as "precisely targeted interactive communication."[3] While Netscape would like to have people think that this is a proprietary system, it is actually a non-proprietary system which can be incorporated into existing web-based projects.

The technology for correct display of these HTML e-mail messages is the recognition of Multipurpose Internet Mail Extensions (MIME) by the e-mail client. Standard e-mail messages employ a MIME "Content-type" of "text/plain". HTML mail is identified by the "Content-type" of "text/HTML".

Multimedia objects can be included for display within HTML mail messages not as attachments but identified by Universal Resource Location (URL). The e-mail message could contain links to resources such a movies, live video, audio, and Java applets. Like standard HTML web documents, HTML e-mail can include electronic forms to collect user inputs and deliver them directly to a web server. When the user clicks on a link or submits a response with the HTML e-mail form, the result is returned to what we now recognize as our Web browser. With the "Netscape Communicator" program this distinction is blurred as the HTML mail message is viewed in a standard browser screen.

HTML e-mail

For non-MIME enabled e-mail readers, links are included at the beginning of the e-mail message which transfer control to the browser. Some e-mail clients do recognize URL formatting and automatically convert the URL into a clickable link. If the e-mail client does not automatically create a hypertext link then the user must copy and paste the URL into to their web browser. For security purposes the URL search argument information is encrypted. Figure 3.

Standard search arguments:
http://netcme.mdacc.tmc.edu/
case.fcgi?user12345&caseD01
Encrypted search arguments:
http://netcme.mdacc.tmc.edu/
case.fcgi?NOQQNNRDODNPNDOND.
Figure 3. URLs with search arguments

In the original NetCME project, when a participant selected a case, an electronic form was dynamically created and sent back to the client. The form included links to case images and an input box for the diagnosis. Hidden form fields stored information regarding user identity. With HTML e-mail, rather than the requiring the participant to request the HTML form, it is automatically created and sent directly via an e-mail message to the participant's e-mail address with content type of text/HTML by Simple Mail Transfer Protocol (SMTP). The individualized e-mail message includes hidden fields for participant identification.

When the participant inputs diagnosis information via the e-mail form, it is sent directly to the server. The submitted form is processed by the web server in the same manner that the original user retrieved HTML web form. Consequently, no alterations of the original CGI routines used to process this HTML form were required. To the server it makes no difference whether the HTML form is submitted from a web browser or from the e-mail client. However, the subsequent HTML form is returned not to the e-mail client but to the web browser.

Project implementation:
The project is implemented on a Power Macintosh 8500 computer, running Web Star 2.0, Filemaker 3.0, and Userland Frontier 4.2. Userland Frontier is a program which integrates the creation of HTML pages and CGI programming. Rather than a single CGI program, Frontier is a scripting environment which integrates aspects of object orientated programming in the creation of web pages. Frontier has built-in sub-routines to control web server CGI functions and others to send SMTP mail messages.

RESULTS

The MIME encoded e-mail message was effective in allowing efficient access to our site. Judging by unsolicited e-mail comments, participants were favorably impressed by the ease of the system and had no difficulty in its use. Users employing Netscape browser were able to submit their diagnoses directly through the e-mail message and results/diagnoses were returned to their standard browser. Participants without MIME enabled e-mail clients were able to click directly on the URL link to enter the case or cut and paste their links. Generated HTML messages were able to automatically display images from the distributed server network.

Although several attempts to break the encryption code were recorded, these were intermittent and messages were sent to the users whose messages were received in altered format.

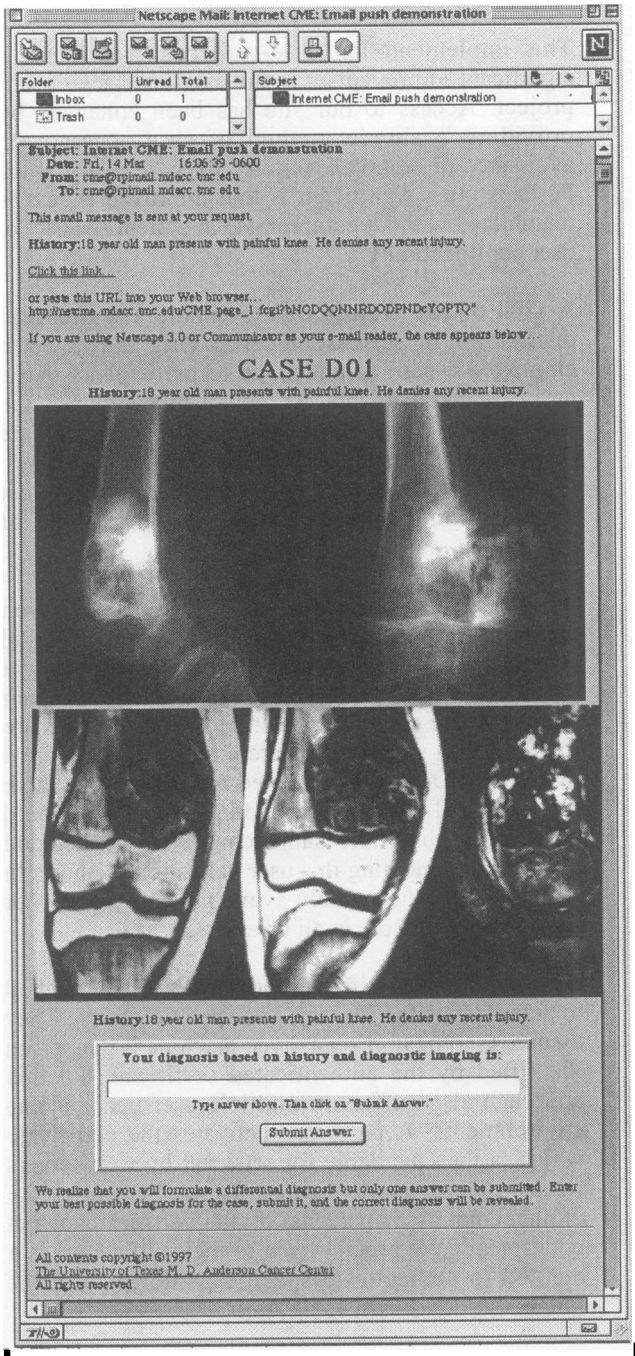


Figure 5. HTML E-mail message viewed with Netscape 3.0 MIME text/HTML message incorporates HTML page directly into e-mail message (refer to figure 2) . This e-mail message functions like standard HTML form. Diagnosis is entered into text input field and submitted directly to project server for assessment.

DISCUSSION

This implementation of e-mail push represents a significant improvement in the user interface for our project. Access to our site has been enhanced by providing a simple method of case access with avoidance of complex routines for case distribution. Perhaps most significant is that improved access is maintained without compromise in system security or user confidentiality.

A goal of our project was to enable a widespread distribution of our case material. Originally we had employed e-mail to announce to participants that a new case was available. As previously mentioned, the user was still required to visit the site and complete the several step sign-on process. With HTML mail, the e-mail messages not only announces the case but includes immediate access to the first page of interaction.

We investigated other methods for automatic sign-on including the use of "cookies" and personal digital certificates. Cookies capture information regarding a specific client machine's visit to a web site and then store it on the client computer. However, cookies are ineffective in situations where multiple users share a machine(s). As we envisioned environments where residents, fellows, and attending physicians would potentially share the same computer we decided against implementing this user validation method. In addition, although widely available, cookies are not universally available in all browsers.

Personal digital certificates[4] are an alternative method to authenticate the identity of a specific person. They assume that the user on a given machine is the person identified by the authenticated certificate but this approach also suffers in multiple user per machine environments. A password activates the certificate which is then available for retrieval by web servers which require authenticated users. Currently, the implementation of personal digital certificates is not widespread. We remain open to their utilization as a method to authenticate specific participants in the future.

Administration of the NetCME project was simplified by eliminating the need to maintain a user name and password database. Access to our site does require a user name and password combination, that of the participant's e-mail account. Utilizing an existing e-mail account for access is much easier to administer and spares interested individuals the bother of establishing another unique user name/ password combination at our site which they may be more likely to forget than their e-mail account sign-on. The program does include routines to quickly update participants' e-mail address if it were to change

Utilization of e-mail distributed access could prove beneficial in situations of shared computer access. In these situations, users are usually protective of their e-mail passwords. With e-mail distribution of case access there is less chance that a user's e-mail password will be shared among a group of users compared to a user name and password that we might issue. This system could prove advantageous in a medical school situation where multiple users share computer terminals but need to be specifically identified prior to taking an on-line quiz. E-mail distribution tests/quizzes could be efficient both for students with their own computer and those who share a computer.

The utilization of pre-selected URL search arguments in web interactions for non-HTML main clients is not a novel solution. It is in common usage with most of the Internet search sites. However, in these situations most of the search parameters being passed to the server are also displayed on the URL location line and could pose a security risk. For instance the URL <HTTP//netcme.mdacc.tmc.edu/case.cgi? user12345& caseD01> leaves little to the imagination as to a person's user name and case example. Consequently, the URL could be easily changed and a user could assume the identity of "user12346". However, an encrypted URL <http://netcme. mdacc.tmc.edu/case.cgi?NODQQNNRDODNPN> is a greater challenge to manipulate especially when a check digit is included. We would hope that a few minutes of unsuccessful experimentation with changing the URL search string parameters would discourage further attempts. While the system will reject an altered URL, the partially correct URL can be saved to an internal file.

The final aspect of system security involves the utilization of an encrypted server for the creation of documents for CME subscribers. Most current e-mail programs do not routinely provide e-mail encryption. Therefore, the message sent to subscribers is non-encrypted. However, when a CME subscriber submits a case diagnosis, the assessment is returned as an encrypted document. The multiple choice questions, which are the basis for objective assessment are answered entirely with encrypted documents. The URL's for CME subscribers in the e-mail messages contain links to the secure server (https://netcme.mdacc.tmc.edu) rather than the standard HTTP server (http://netcme.mdacc.tmc.edu). If e-mail encryption becomes widely available we certainly anticipate encrypting the entire e-mail message sent to participants.

A limitation to the e-mail service is that unlike standard e-mail which can be read "off-line", a person must be "on-line" to review cases. We expect users will quickly adapt to this situation and only read e-mail from our project while on-line so that images are downloaded and user responses can be transferred to the central server.

Numerous Internet-based medical educational projects have been developed which could be enhanced by this access system. Electronic medical journals[5] could deliver relevant articles directly to a subscriber rather than relying upon subscriber visits the journal's web site. Internet distribution of clinical results has also been described[6] which could be enhanced by a shift to a "push" distribution model delivering pertinent results directly to clinicians the instant they become available.

The content "push" model enables a shift in the delivery of CME or other professional assessment materials. Rather than CME being presented as the typical one hour lecture or instructional videotape, CME could evolve into multiple, several minute interactions with continuous assessment potentially incorporated into daily work routines. One could envision an assessment system where radiographs, pathology slides, EKG tracing, endoscopy images, and clinical problem could be "pushed" into a clinician's general work flow and mini-assessments could occur which, in aggregate, form an overall continuous assessment. While such a system would be difficult to administer with traditional paper-based educational delivery mechanisms, the Internet provides the infrastructure, enabled though distribution mechanisms such as we have described, to implement such a system.

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